

**Supplementary Table S1.** Demographic data and tumor related information of the renal cell carcinoma patients enrolled in the study.

<b>Number</b>	<b>Age (years)</b>	<b>Sex</b>	<b>Tumor histology</b>	<b>Tumor grade</b>	<b>TNM stage</b>	<b>Stage</b>
<b>1</b>	51	F	Clear cell carcinoma	3	T1bN0M0	1
<b>2</b>	60	M	Clear cell carcinoma	1	T1a N0M0	1
<b>3</b>	41	M	Clear cell carcinoma	1	T1a N0M0	1
<b>4</b>	66	M	Clear cell carcinoma	1	T1a N0M0	1
<b>5</b>	59	F	Clear cell carcinoma	1	T1b N0M0	1
<b>6</b>	52	M	Clear cell carcinoma	2	T1a N0M0	1
<b>7</b>	41	M	Clear cell carcinoma	1	T1a N0M0	1
<b>8</b>	63	M	Clear cell carcinoma	1	T1b N0M0	1
<b>9</b>	58	F	Clear cell carcinoma	1	T1a N0M0	1
<b>10</b>	59	F	Clear cell carcinoma	2	T1a N0M0	1
<b>11</b>	50	M	Clear cell carcinoma	3	T2b N0M0	2
<b>12</b>	48	M	Clear cell carcinoma	3	T2b N0M0	2
<b>13</b>	59	M	Clear cell carcinoma	2	T3aN0M0	3
<b>14</b>	66	M	Clear cell carcinoma	2	T3a N0M0	3
<b>15</b>	59	F	Clear cell carcinoma	2	T3a N0M0	3
<b>16</b>	53	M	Clear cell carcinoma	2	T3a N0M0	3
<b>17</b>	49	F	Clear cell carcinoma	1	T3a N0M0	3
<b>18</b>	68	F	Clear cell carcinoma	2	T3a N0M0	3
<b>19</b>	64	F	Clear cell carcinoma	1	T3a N0M0	3
<b>20</b>	64	M	Clear cell carcinoma	2	T3b N0M0	3
<b>21</b>	71	M	Clear cell carcinoma	3	T3b N0M0	3
<b>22</b>	68	M	Clear cell carcinoma	2	T3a N0M0	3

23	46	M	Clear cell carcinoma	2	T3a N0M0	3
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**Supplementary Table S2.** Demographic data of control patients.

Number	Age (years)	Sex
1	79	M
2	56	M
3	59	M
4	46	M
5	57	M
6	71	M
7	80	M
8	64	F
9	70	F
10	68	M
11	71	M
12	36	F
13	46	M
14	65	M
15	41	F
16	45	M
17	75	M
18	45	M
19	76	F
20	54	M
21	37	F
22	37	M
23	60	M
24	58	M
25	59	M
26	55	F
27	58	F

**Supplementary Table S3.** The performance metrics for the classification of Stage 1 renal cell carcinoma and control group patients based on surface-enhanced Raman scattering (SERS) spectra of serum using three classification algorithms (random forest, kNN and naïve Bayes). PCs 2, 6 and 9 were used as input for the machine learning algorithms. AUC - area under the curve; CA - classification accuracy; F1 - score representing the harmonic mean of precision and recall; Precision - positive predicted value; Recall - sensitivity.

Statistical model	AUC	CA	F1	Precision	Recall
Random forest	0.78	0.75	0.76	0.76	0.75
kNN	0.73	0.73	0.70	0.70	0.73
Naïve Bayes	0.67	0.73	0.70	0.70	0.73

**Supplementary Table S4.** The performance metrics for the classification of Stage 3 renal cell carcinoma and control group patients based on surface-enhanced Raman scattering (SERS) spectra of serum using three classification algorithms (random forest, kNN and naïve Bayes). PCs 2, 6, 9 and 12 were used as input for the machine learning algorithms. AUC - area under the curve; CA - classification accuracy; F1 - score representing the harmonic mean of precision and recall; Precision - positive predicted value; Recall - sensitivity.

Statistical model	AUC	CA	F1	Precision	Recall
Random forest	0.86	0.78	0.77	0.78	0.78
kNN	0.72	0.68	0.69	0.70	0.68
Naïve Bayes	0.88	0.84	0.84	0.85	0.84

**Supplementary Table S5.** The performance metrics for the classification of Stage 1 and 3 renal cell carcinoma and control group patients based on surface-enhanced Raman scattering (SERS) spectra of serum using three classification algorithms (random forest, kNN and naïve Bayes). PCs 1 and 9 were used as input for the machine learning algorithms. AUC - area under the curve; CA - classification accuracy; F1 - score representing the harmonic mean of precision and recall; Precision - positive predicted value; Recall - sensitivity.

Statistical model	AUC	CA	F1	Precision	Recall
Random forest	0.90	0.81	0.81	0.81	0.81
kNN	0.66	0.71	0.71	0.72	0.71
Naïve Bayes	0.86	0.71	0.71	0.72	0.71